VI. RELATION BETWEEN THE HEAD, THE PRESSURE AND THE VELOCITY OF CURRENTS OF LIQUIDS AND GASES

If the velocity of flow of any current is considered, as in a canal or a river, it is a function of the head expended. As the bottom or bed of a torrent of water is never smooth, the velocity of flow is only maintained by the expenditure of a velocity head sufficient to compensate for the velocity lost at the obstructions. The water in a stream flows only when its free upper surface has a sufficient slope or hydraulic gradient to cover the loss of velocity due to the friction against the bottom and sides of the stream.

Therefore, *there will be no flow or current unless there is a corresponding loss of velocity head, and if there is a flow there will be a corresponding loss of velocity head in impressing this velocity upon the stream and in maintaining it.*

If the velocity of the flowing current is v, then

$$\frac{v^2}{2g} \text{ and } /\& = \bullet\text{«-}$$

in which h represents the velocity head expressed in terms of the liquid in motion (water, kerosene, liquid iron, mercury, etc.).

For example, when any liquid is impressed with a velocity of flow of 4 m 43 per second, there will be required, according to the formula, the expenditure of a velocity head h of 1 m. This will be 1 meter in height of water, kerosene, liquid iron, mercury, or of the particular liquid which is in motion.

If this meter of velocity head is expressed in kilograms per square meter, it will be found that, for each of these different liquids, a different pressure is required to produce the same velocity of 4 m 43 per second, according to their density, as follows:

Liquid	Kilograms per square meter	Atmospheres	Millimeters of water
Kerosene	800	0 08	800
Water	1000	0 10	1 000
Liquid iron.	6 900	0 69	6 900
Mercury. . .	13 595	1 3595	13 595